

HR-372 Measurements of Ice Scraping Forces on Snow-Plow Underbody Blades

Key Words:

ABSTRACT

Ice or compacted snow on the roadway represents a severe winter hazard that can occur quite often in the winter months. There are three methods that are typically used to remove ice or compacted snow from the roadway: Chemical, mechanical and noncontact methods. The procedure commonly used consists of salting and sanding the roadway while using a front mounted plow and/or an underbody plow to remove snow and ice. This project builds upon project HR 334, with two major developments. In this study, several new cutting edges were tested in a series of closed road tests. These new cutting edges consisted of a variety of serrated shapes. The study also included measurement of ice scraping forces by in-service trucks. These in-service trucks were two Iowa Department of Transportation trucks from the Oakdale shop. These trucks were instrumented in a similar manner as the truck used in the closed-road tests. These trucks provided data from real life ice or compacted snow removal situations.

Results from the closed-road and in-service tests were analyzed by two parameters. The first parameter is the scraping effectiveness, which is defined as the average horizontal force experienced by a cutting edge. The amount of ice scraped from the roadway is directly proportional to the magnitude of the scraping effectiveness. Thus an increase in scraping effectiveness indicates an increase in the amount of ice being scraped from the roadway. The second parameter is force angle, which is defined as:

$$\text{Force Angle} = \tan^{-1} [\text{Vertical Force} / \text{Horizontal Force}]$$

A combination of a minimal force angle and a maximized scraping effectiveness represents a case in which the maximal amount of ice is being removed from the pavement without an exceptionally large vertical force. Results indicate that each cutting edge produced a maximal scraping effectiveness with a testing configuration of-

* Blade Angle = 15'

* Download Force = High (23,000 lbs)

Results also indicate that each cutting edge produced a minimal force angle with a testing configuration of-

Blade Angle = 15'

Download Force = Low (10,000 lbs)

Results from the in-service trucks produced similar data and also similar trends within the data when compared to the results of the closed-road tests. This result is most important, as it suggests that the closed-road tests do provide an accurate measure of ice scraping forces for a given blade and configuration of that blade. Thus if the closed-road tests indicate that certain blades perform well, there is now excellent reason to conduct full scale tests of such blades.